It is very satisfactory to find a considerably closer agreement between the two systems of fundamental star places, due to the application of the definitive corrections deduced by Professor Auwers, than formerly obtained. The great improvement that has been effected in this respect is made obvious by comparing the reduction tables given above, for 1906, with those in Dr. Cohn's paper published in *Astron. Nachrichten*, No. 3742, which exhibit similar quantities applicable to the provisional fundamental catalogues of the *Astronomische Gesellschaft*, for the epochs 1875 and 1900. In particular it will be noticed that the right ascensions of stars of moderate declination are now in very close accord indeed; due not only to the agreement in the adopted position of the equinox in the respective systems, but also to the agreement (at the epoch considered) in the mean positions of groups of stars extending over a considerable range of declination.

H.M. Nautical Almanac Office:
1904 *May* 9.

Note on a Suggested Method of Determining the Declination of Stars. By A. E. Conrady.

The values of the declination of stars and of the latitude of observatories depend directly on the readings of graduated circles, and are limited to the accuracy with which the errors of graduation and of flexure have been, or can be, determined, besides involving errors of the refraction tables.

The following method of determining the declination of stars not too near the equator requires circle readings of a lower order of accuracy than that of the resulting declinations. I believe it is novel; whether it is of practical value remains an open question.

When the idea first occurred to me (1899 March 21) I began my note of it as follows:

"The clock is without doubt the most accurate and cheapest instrument for measuring angles; and in the case of many observations, made at different periods of the day and of the year, it is entirely free from constant errors.

"The question arises, whether declinations and latitude might not be obtained by transit observations based on observations of time only. This is indeed possible."

The method calls for a transit instrument in the meridian firmly united with a second telescope which has its optical axis parallel to the plane defined by the axis of rotation and the optical axis of the principal telescope, and is capable of being

fixed in any direction intermediate between that of the axis of rotation and that of the principal telescope.

When the principal telescope describes the meridian the auxiliary telescope describes a small circle parallel to the meridian. Then the angular distance between the two telescopes, for which the symbol C seems appropriate (for it really represents a very large intentional collimation error), is connected with the hour-angle t, at which a star of declination δ passes the small circle by the equation

$$\sin C = \sin t \cos \delta \quad \ldots \quad \ldots \quad (1)$$

For stars near the equator $\cos \delta$ differs but slightly from unity, and an error in the assumed value of δ has but very little effect on the resulting value of C; hence C may be determined by transits of equatorial stars without requiring an accurate knowledge of their declination, and if the stars are also observed in the principal telescope, errors in the tabular right ascension, as well as small errors in the position of the instrument, will also be eliminated.

C being thus determined, the telescopes are directed towards the pole and six-hour circle, when stars of declination nearly equal to C can be observed either by transit or, preferably, by micrometrical bisections in the manner which is practised with the transit instrument in the prime vertical. A transposition of equation (1) then gives the declination as

$$\cos \delta = \frac{\sin C}{\sin t} \quad \ldots \quad \ldots \quad (2)$$

and as t is now nearly 90° this observation is practically free from errors in the time or in the R.A. of the observed stars. The principal telescope will, of course, be used in both positions to control the instrumental constants.

It would at first sight seem that these observations would be affected by refraction even more strongly than measurements with the meridian circle, but in reality the refraction is to a very great extent eliminated; for if we consider the triangle between zenith, star, and the spherical perpendicular C, calling the angle at the star p, we shall have the differential relation

$$\partial C = \partial \zeta \cos p$$

$\partial \zeta$, being the refraction, is very nearly equal to a constant R multiplied by the tangent of the zenith distance, or

$$\partial C = R \operatorname{tg} \zeta \cos p.$$

But the same triangle also gives

$$\cos p = \frac{\operatorname{tg} C}{\operatorname{tg} \zeta}.$$

and, introducing this, we get

$$\partial C = R \operatorname{tg} C \qquad \ldots \qquad \ldots \qquad (3)$$

that is to say, the refraction uniformly raises the small circle without interfering with its parallelism to the corresponding vertical great circle. Therefore the effect of refraction in these observations is limited, besides second-order terms, which are amenable to computation, to the comparatively slight departures from the tangent law and to the effects of changes in the density of the atmosphere, both of which are more accurately known within the narrow limits which come into question than the total amount of the refraction for similar zenith distances.

Flexure of the instrument next suggests itself as a source of error. This also will be eliminated to a very great extent if, after observing the equatorial stars, the instrument is reversed in its bearings for the observations on the six-hour circle, as the instrument will then remain very nearly in the same position with regard to the direction of gravity.

It is obvious that the method could be most advantageously used in an observatory on the 45th parallel, where the elimination of errors would be most complete, and that it could not be used at all either near the equator or near the poles.

The declination of suitable stars having been determined, the latitude of the place of observation could be obtained by the zenith telescope or by a transit instrument in the prime vertical, again without involving close readings of graduated circles.

It would seem that this method could be advantageously carried out photographically, photographs of equatorial and six-hour regions being taken on the same plate, the resulting star traces forming approximately right angles with each other and being thus clearly distinguished.

Bedford Park, W.: 1904 *May* 10.

Micrometrical Measures of Double Stars made with the 17¼*-inch Reflector. Second Series.* By the Rev. T. E. Espin, M.A.

In the following list Column 1 gives the number in Σ, OΣ, &c., Column 2 the approximate R.A. and decl. for 1880, Column 3 the position angle, Column 4 the distance, Column 5 the number of nights, Column 6 the magnitudes, Column 7 the date, and Column 8 any notes. In addition to the usual symbols, A.G. refers to stars found double in the Catalogue of the *Astronomische Gesellschaft.* Under the heading Various Stars will be found several new pairs that have been detected since the last list was published, or have been accidentally omitted.